DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the method of applying coating liquid to the substrate which has a "wave", a "warp", and "thickness unevenness" by fixed thickness about the method of application of a die coating machine.
[0002]
[Description of the Prior Art] The spin coater which the former, for example, a glass substrate, is made to rotate a glass substrate as a method of applying photoresist liquid, and applies photoresist liquid is known. However, in the above-mentioned spin coater, since it is discarded without moreover reusing 95% of photoresist liquid, without being applied to a glass substrate, the yield of coating liquid becomes very bad. Then, its attention is paid to the method of application by the die coating machine with the sufficient yield of coating liquid.
[0003] By the way, a die coating machine can carry out a uniform application, without generating paint nonuniformity, if the substrate itself is flat. However, since almost all glass substrates had a "wave", a "warp", and "thickness unevenness" in itself, the gap of a glass-substrate front face and a die coating machine changed with the above "thickness unevenness" etc., and the stripes of a shade had generated them in the paint film.
[0004] For this reason, when a glass substrate has "thickness unevenness" etc., it is necessary to apply it, as it is kept constant, the distance, i.e., the real gap, of the die point (nozzle) which changes with "thickness unevenness" etc., and the front face of a glass substrate. As a method of applying, while holding the real gap at the time of an application uniformly, there are some which were indicated by JP,7-328513,A "a processing liquid coater."
[0005] This method forms a sensor in a die coating-machine main part, and measures the interval of the nozzle of a die coating-machine main part, and a substrate by the above-mentioned sensor at the time of an application, and makes the above-mentioned nozzle and a substrate approach and desert relatively with measured value, and controls an interval to constant value.
[0006] However, by this method of moving a nozzle or a substrate simultaneously with measurement, since time required for measurement of a real gap and time required for the operation of the deflection of a real gap and a criteria gap (gap beforehand set up in order to obtain desired film thickness) were not fully securable, control of a real gap could not be followed to application speed, but there was a problem that coating liquid could not be applied to uniform thickness.
[0007] moreover, by the method of measuring a real gap by the upstream of an application position which is indicated by JP,5-185022,A "the direct method of application of the resin to a metal plate", and securing the above-mentioned operation time As shown in <u>drawing 4</u> , even if the several microns error 34 (level difference) exists in the height direction in respect of [33] substrate installation in the application position by the substrate installation side 31 and the die coating machine 32 in a real gap measuring point which measure a gap with Substrate W by the sensor 30 measuring this error 34 -- very much -- difficult -- this sake -- a zero amendment -- there was a problem that a real gap could not be

held about a desired criteria gap even if it makes the motor 36 which approaches and deserts Substrate W in the die coating machine 32 with a controller 35 drive, since things are not made
[0008] Then, this invention is made in view of the above-mentioned trouble, and aims at offering the method of application of the die coating machine which applies coating liquid to uniform thickness to the substrate which has a "wave", a "warp", and "thickness unevenness."
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention lays a substrate on a flat table. Move a die coating machine relatively to this substrate, and it faces [applying on the above-mentioned substrate, and]. Form a range-measurement machine in the above-mentioned die coating machine, and the real gap of the above-mentioned die coating machine and a substrate is measured beforehand in all application regions. It is characterized by applying making it go up and down the above-mentioned die coating machine to a substrate based on this operation value at the time of an application, after calculating the deflection of the above-mentioned real gap and a criteria gap in all these application regions.
[0010]
[Embodiments of the Invention] Hereafter, the form of the operation which relates to this invention with reference to an accompanying drawing is explained. Drawing 1 shows the die coating machine 1 to which the method of application of the die coating machine concerning this invention is applied. The above-mentioned die coating machine 1 equips with the non-contact formula range-measurement sensor 3 the lifting device 2 and longitudinal direction center section which consist of a ball screw mechanism of a servo motor and non backlash in the center of the upper part of the longitudinal direction of this die coating machine 1. The above-mentioned lifting device 2 and the above-mentioned sensor 3 are connected through the control unit 4. Moreover, the tank 8 into which the photoresist liquid 7 which is coating liquid went through the application liquid feed pump 6 is connected to the die coating machine 1. In addition, the above-mentioned sensor 3 may be not only the thing of a non-contact formula but a contact process.
[0011] Opposite arrangement of the table 12 is carried out at the die point 11 of the die coating machine 1. The upper surface of the above-mentioned table 12 has the flatness of 2 micrometers or less, and the grid-like slot 13 is formed in the upper surface, and these slots 13 are connected to the vacuum pump (not shown) through the breakthrough 14. By drawing in with a vacuum pump, adsorption maintenance is carried out on the above-mentioned table 12, and glass-substrate W laid in the above-mentioned table 12 can correct a "warp" and a "wave" now.
[0012] Next, the method of application of the above-mentioned die coating machine 1 is explained. 0.06 Pa-s and surface tension sigma use [viscosity mu] a 30x10 to 3 N/m thing, and what has the flexibility to which glass-substrate W processed the size into 550mmx650mm, and it processed thickness into 1.1mm**10micrometer is used for photoresist liquid 7. Moreover, 10 mm/s and application thickness h are set to 10 micrometers for the application speed U.
[0013] In this case, the capillary number by experiment of "Chemical Engineering Science, Vol.47, No.7 pp 1703-1713, Lee and others currently indicated by 1992", the maximum gap for which it asked using the relation (drawing 2) of the dimensionless minimum application film, and the minimum gap determine the criteria gap H of the die coating machine 1 and a substrate W front face. Namely, the range of the criteria gap H which can be applied by predetermined application thickness The maximum gap which substituted for "the-two number" the dimensionless minimum application thickness t it is decided with the application of capillary-number calcium which substituted the physical-properties value and application speed of application liquid for "the-one number", and found them that will be drawing 2 , and asked for it, It exists between the minimum gaps which substituted for "the-two number" the dimensionless minimum application thickness t decided from the critical value 0.1 of capillary-number calcium which can be found from drawing 2 , and asked for it.
[0014]
[Equation 1] Calcium=mu U/sigma [0015]
[Equation 2] t=h/H, in addition mu: Viscosity (Pa-S)

U: Application speed (m/s)

sigma: Surface tension (N/m)

h: The minimum application thickness (micrometer)

H: It is a gap (micrometer).

[0016] In addition, the above-mentioned maximum gap is threshold value it becomes impossible to hold the surface tension of application liquid but to form a meniscus between a die coating machine and a substrate when a gap is extended more than it. If the minimum gap is threshold value a gap is too narrow and it becomes impossible to form a meniscus and is between the maximum gap and the minimum gap when a gap is narrowed more than it The surface tension of application liquid (meniscus) will absorb change of a gap for the duty of a shock absorber sure enough, and will form predetermined thickness.

[0017] Specifically the maximum of the criteria gap H of the die nose of cam 11 of the die coating machine 1 and glass-substrate W Viscosity mu (0.06 Pa-s), surface tension sigma (30x10-3 N/m) of photoresist liquid 7 Substitute the application speed U (10 mm/s) above "a-one number", and capillary-number (number of capillary tubes) calcium (0.02) is calculated. This value is applied to the graph of drawing 2 , the dimensionless minimum application thickness t (0.15) is read, the above-mentioned dimensionless minimum application thickness t (0.15) and the application thickness h (10 micrometers) are substituted for "the-three number" which transformed the above "a-two number", and it is decided that it will be 66 micrometers.

[0018]

[Equation 3] H=h/t [0019] Moreover, since the critical value of capillary-number calcium is 0.1, the minimum value of the criteria gap H is determined as 16 micrometers from drawing 2 and "a-three number" to the application thickness h (10 micrometers). Therefore, the criteria gap H is set as the any value between the criteria gap ranges of 16-66 micrometers which can be applied.

[0020] And it faces applying, and first, adsorption maintenance of the glass-substrate W is carried out with a vacuum pump on a table 12, and the "warp" and a "wave" of glass-substrate W are corrected. Thereby, the factor to check serves as "thickness unevenness" of a glass substrate about applying application thickness uniformly.

[0021] As shown in drawing 3 (a), after setting the criteria gap H of the die nose of cam 11 and glass-substrate W as the arbitrary position between 16-66 micrometers, as shown in drawing 3 (b) About all the application regions 15 where the die coating machine 1 is moved according to the move mechanism which is not illustrated, and the photoresist liquid 7 of glass-substrate W is applied, by the non-contact formula range-measurement sensor 3, before applying the distance of the die nose of cam 11 and a glass-substrate W front face, i.e., a real gap, it measures beforehand. And based on the data of the measured real gap, the deflection of a real gap and a criteria gap is calculated with a control unit 4. Since the installation side of the table 12 in a real gap measuring point and the installation side of the table 12 in an application position are the same at this time, amendment of the level difference of an installation side is unnecessary in a real gap measuring point and an application position.

[0022] In addition, in the above-mentioned operation, the time lag of application speed and the rise-and-fall speed at the nose of cam 11 of a die is also taken into consideration.

[0023] In the place which the operation ended as mentioned above, as shown in drawing 3 (c), the die coating machine 1 is moved, photoresist liquid 7 is supplied to the die coating machine 1 from a tank 8 by the application liquid feed pump 6, and an application is started. In the case of application operation, you make it go up and down the die coating machine 1 by the lifting device 2, the distance (real gap) of the die nose of cam 11 and the front face of glass-substrate W is always maintained identically to the criteria gap H, and an application film is uniformly applied to the thickness of 10 micrometers. Thus, in the case of application operation, since time lag with application speed is taken into consideration also about the speed which has ended the operation for outputting the signal which makes it go up and down the die nose of cam 11 to glass-substrate W before an application start, and goes up and down the die coating machine 1, uniform film thickness can be easily obtained over the substrate whole region. In addition, in case a real gap is measured by the non-contact formula range-measurement sensor 3, in order to raise the accuracy of measurement, you may set the traverse speed of the die coating machine 1

as a low speed from application speed.

[0024] By the way, in the method of application of the above-mentioned die coating machine 1, since the time lag of application speed and the rise-and-fall speed at the nose of cam 11 of a die is also taken into consideration and it is calculating with the control unit 4, even if application speed becomes quick, for example by the increase in the quantity of production and the criteria gap range which can be applied becomes narrow, a real gap is always identically [to the criteria gap H] maintainable. That is, since time lag with application speed is taken into consideration also about the speed which goes up and down the die coating machine 1, application speed can be set up freely.

[0025] In addition, substrates may be the rigid bodies, such as what [not only] has flexibility like the above-mentioned glass-substrate W but rigid resin. In this case, a substrate does not need to stick to a table 12.

[0026] Furthermore, although a lifting device 2 and every one non-contact formula range-measurement sensor 3 are formed in the above-mentioned die coating machine 1, respectively, a lifting device 2 may also attach every one a total of two and non-contact formula range-measurement sensor 3 in the ends of the up cross direction of the die coating machine 1 respectively corresponding to two lifting devices 2 to every a total of two one ends of the flank cross direction of the die coating machine 1, respectively. In the die coating machine 1 of the above-mentioned composition, since it can go up and down the die nose of cam 11 to glass-substrate W crosswise, the criteria gap H is uniformly maintainable about the "thickness unevenness" of the cross direction of a glass substrate.

[0027]

[Effect of the Invention] In the method of application of the die coating machine concerning this invention, so that clearly from the above explanation The real gap at the application portion of a substrate and the nose of cam of a die is beforehand measured before application operation by the above-mentioned sensor. Since it calculates before applying the deflection of this real gap and a criteria gap, and you are making it go up and down a die coating machine to a substrate based on the above-mentioned result of an operation in the case of application operation, at the time of application operation you make it go up and down a die nose of cam -- sufficient -- since there is no need of going up and down measurement, an operation, and a die nose of cam simultaneously, like before, even if it is the case that application speed is quick, it can go up and down a die nose of cam so that a criteria gap may be maintained Therefore, even if a substrate and a die nose of cam are under a precise application condition [as / whose precision of thickness the thickness of an application film is the thickness which is about 10 micrometers, and is moreover less than **5% since a criteria gap is always maintained irrespective of application speed even if it is the case where a substrate has a "wave", a "warp", and "thickness unevenness"], a desired application film can be formed. Moreover, since the non-contact formula range-measurement sensor is attached in the die coating machine in one, there is no gap of a die nose of cam and each datum level of a sensor, and a real gap can be measured correctly.

[0028] Moreover, if coating liquid is applied to the flat table equipped with the suction mechanism where adsorption maintenance is carried out when the above-mentioned substrate is flexibility, since the "wave" and a "warp" of a substrate will be corrected, the application film of desired thickness can be more precisely formed in a substrate.

[Translation done.]